

RADAR SAFETY

You are now a radar systems technical expert. As an Electronics Technician, Second Class, and possible work center supervisor, you also must understand the basic safety requirements for radar maintenance and operation.

In ET Volume 1, *Safety*, we discussed the following safety items that apply to radar: (1) the proper handling of cathode-ray tubes (CRTs), (2) measuring voltage on energized equipment, (3) the use of protective equipment, (4) tag-out procedures, (5) working aloft, and (6) RF hazards.

We will not cover that material in this volume. However, we will test your understanding of that material in the NRTC for this volume. Therefore, if you have not completed Volume 1, you may want to do so before proceeding with this course.

RADIATION HAZARDS

Much of your radar gear (if labeled correctly) will have radiation hazard (RADHAZ) warnings attached. These labels indicate a radiation hazard producing RF electromagnetic fields intense enough to actuate electro-explosive devices, cause spark ignition of volatile combustibles, or produce harmful biological effects in humans. You will probably not be able to eliminate the hazards caused by normal operation of your radar equipment. Therefore, you will need to minimize them during certain evolutions.

The most effective way to reduce radiation hazards is to shut down equipment when possible or to locate equipment so that radar main beams do not illuminate ordnance, personnel, or fuels.

NAVSEA OP 3565 requires each commanding officer to establish procedures for maintaining positive control of RF transmitting equipment and to coordinate the actions of personnel working near emitters or handling ordnance. By instruction, no one may turn on any transmitting equipment without proper authorization from the supervisor in charge of operations. That means that you need permission to operate, test operate, rotate, or radiate electronic gear.

Each command has an Emissions Control (EMCON) Bill that establishes the level of EMCON

required during certain types of operations. The EMCON bill identifies the equipment to be secured while each EMCON level is set. Label your radar equipment according to your EMCON bill to make identification easy and to provide for timely shut down.

The following paragraphs discuss the primary adverse affects of electromagnetic radiation on material and personnel and the programs designed to minimize those effects.

HERO—HAZARDS OF ELECTROMAGNETIC RADIATION TO ORDNANCE

During on-loading or off-loading of ammunition, there is a danger that RF electromagnetic fields could accidentally activate electro-explosive devices (EEDs) or electrically-initiated ordnance. This is a very real hazard to the ordnance, the ship, and the crew. The HERO program was developed to control these types of situations.

When HERO is set, it usually requires that radars be secured. When you are in port and must conduct any radar maintenance requiring rotating the antenna or radiating, always coordinate your actions with Base Operations via the CDO. HERO conditions anywhere in the area could be affected by your radar. Even if you just want to radiate a short period for an operational test, check with the OOD or CDO first.

Table 4-1 identifies ordnance hazards associated with common electronic equipment. This is an example of tables found in NAVSEA OP 3565 Volume II, part 1.

HERF—HAZARDS OF ELECTROMAGNETIC RADIATION TO FUELS

The HERF program was developed to protect fueling operations. During fueling operations, RF electromagnetic fields with a large enough intensity could produce a spark that could ignite the volatile combustibles. Therefore, certain radars may need to be shut down during fueling operations. Check your HERF publications for specific details.

Table 4-1.—NAVSEA OP 3565 Volume II, Table 2-4, Safe Separation Distances for Radar, EW, and NAVAIDS Equipment

SYSTEM	GAIN (dBi)	HERO SUSCEPTIBLE (METERS/FEET)	HERO UNSAFE/ HERO UNRELIABLE (METERS/FEET)
AN/SPS-10	32	37/121	52/171
AN/SPS-10 (Beacon Mode)	32	34/112	49/161
AN/SPS-10B	30	48/157	67/220
AN/SPS-10B (Beacon Mode)	30	43/141	61/200
AN/SPS-10C, 10E, 10F	30	36/118	51/167
AN/SPS-10C (Beacon Mode), 10E (Beacon Mode)	30	33/108	47/154
AN/SPS-10D	31	40/131	57/187
AN/SPS-10D (Beacon Mode)	31	38/125	53/174
AN/SPS-10F (Beacon Mode)	30	34/112	48/157
AN/SPS-12	28.2	3170/10400	5799/19025
AN/SPS-29A, 29B, 29C, 29D, 29E	18	157/515	609/1998
AN/SPS-30	40.4	1070/3510	1509/4951
AN/SPS-32	22	426/1398	1644/5394
AN/SPS-33	44	1532/5026	2160/7087
AN/SPS-35 LR, 35 SR	31	3/10	3/10
AN/SPS-37	18.5	111/364	429/1407
AN/SPS-37A	23	186/610	719/2359
AN/SPS-39A	39.5	593/1946	836/2743
AN/SPS-40, 40A	21	203/666	610/2001
AN/SPS-40B (LFDM), 40C (LFDM), 40D (LFDM)	21	143/469	432/1417
AN/SPS-40B (LRM), 40C (LRM), 40D (LRM)	21	216/709	652/2139
AN/SPS-43	18.5	114/374	449/1473
AN/SPS-43A	23	191/627	755/2477

HERP—HAZARDS OF ELECTROMAGNETIC RADIATION TO PERSONNEL

The HERP program was developed to protect personnel from RF electromagnetic radiation. Anywhere a radar or transmitter is operating, there is a danger that the RF electromagnetic fields may produce harmful biological effects in humans exposed to them. The following paragraphs identify the typical hazards and the steps you can take to minimize them.

Hazards

RF hazards to personnel are based on overexposure to RF energy. The biological hazard level for exposure to RF radiation is established by the Bureau of Medicine and Surgery and is included in NAVSEA OP 3565 Volume I.

SAFE LIMITS.— Safe limits are based on the power density of the radiation beam and the exposure time of the human body. Table 4-2 identifies safe limits associated with common electronics equipment. It is an

example of tables found in NAVSEA OP 3565 Volume I.

RF BURNS.— As we mentioned in ET Volume 1, voltages of enough potential to cause a burn injury can be induced on metallic items from nearby transmitting antennas. However, there has to be actual physical contact for the burn to occur. You can help prevent contact by ensuring that warning signs are placed properly and obeyed.

Precautions

During normal operations, personnel can easily avoid most hazards if the hazards are labeled properly. However, during maintenance, some hazards must be eliminated by specific, planned actions, such as those listed below. Using all safety precautions is the personal responsibility of the technician.

TAG-OUT.— Tag-out procedures are covered in depth in ET Volume 1. Hanging a proper tag can save your life. Using tags improperly or not at all will eventually put you, maybe your best buddy, maybe your

Table 4-2.—NAVSEA OP 3565, Volume I, Table 2-1, Personnel Hazards from Continuous or Intermittent Exposure to Main Beam Radiation

TRANSMITTER	MODE	FIXED BEAM HAZARD			MOVING BEAM		
		DISTANCE		MAX. EXP. TIME ^(a)	PERSONNEL HAZARD	DISTANCE	
		METERS	FEET			METERS	FEET
SHIPBOARD AND SHORE STATION EQUIPMENT (Continued)							
AN/SPS-37A		14	45	0	NO	-	-
AN/SPS-38		15	50	0	NO	-	-
AN/SPS-39, A		120	400	1	NO	-	-
AN/SPS-40, A, B		18	60	1	NO	-	-
AN/SPS-41		NO HAZARD		6	NO	-	-
AN/SPS-42		55	180	1	NO	-	-
AN/SPS-43		21	70	0	NO	-	-
AN/SPS-43A		14	45	0	NO	-	-
AN/SPS-45		14	45	0	NO	-	-
AN/SPS-46		NO HAZARD		6	NO	-	-
AN/SPS-48**		250	840	0	NO	-	-
AN/SPS-49		61	200	1	NO	-	-
AN/SPS-51		NO HAZARD		6	NO	-	-
AN/SPS-52		130	440	0	NO	-	-
AN/SPS-53, A, E		NO HAZARD		6	NO	-	-
AN/SPS-55		8	25	0	NO	-	-
AN/SPS-57		NO HAZARD		6	NO	-	-
AN/SPS-58		NO HAZARD		6	NO	-	-
AN/SPS-58A		NO HAZARD		6	NO	-	-

whole crew, in a Navy mishap report. Ensure that required tags are installed properly and observed fully.

MAN-ALOFT CHITS.— Man-Aloft chits protect you from RF hazards when you are working on radar antennas. If the chit is run properly, the operations on your ship and any ship next to you are modified to keep you safe. Heed the requirements and follow the procedures.

EQUIPMENT SAFETY DEVICES.— Devices built into equipment, such as cut-off switches on antennas, are for your safety. A cut-off switch, when set, will keep you out of danger. It will prevent someone from rotating the antenna from a remote location. But, you, the technician, have to set the cut-off switch for it to be of any use. Equipment safety devices are there for your protection. Use them!

Everywhere you go in the Navy, there will be communications and radar equipment that produces an Electromagnetic Radiation Environment (EME). And, there will always be electromagnetic radiation hazards introduced by operating this equipment. To be safe,

become familiar with the hazards associated with your equipment. If you install new equipment, update your EMCON bill. Use NAVSEA OP 3565 Volume I or Volume II to determine the hazards associated with the equipment.

OTHER RADAR HAZARDS

You cannot always avoid hazards when working on radars. In these instances, take what precautions you can and at least be prepared for an emergency. As we discussed in ET Volume 1, there are various safety concerns associated with working on energized equipment, going aloft, or handling CRTs.

ENERGIZED EQUIPMENT

You may have to work on energized equipment on a hectic bridge, in a crowded CIC, or in a cramped radar equipment room. These are not ideal safety environments. As these spaces are maintained by various people, always check the rubber matting around your equipment. Also check other protective

equipment, such as rubber gloves and shorting probes before using them.



**SHOCK
HERTZ!**

WARNING!

NEVER WORK ALONE ON ENERGIZED EQUIPMENT.

On ships with minimum manning, you may not have the option of using another ET as a safety observer. Make sure that whoever is going to observe you is CPR qualified. Brief your observer on what you will be doing. Physically show him or her where the cut-off switch is located. Have him or her stand by at a safe distance with a rope or wooden cane to pull you from the equipment, should you get hung up. Follow procedures outlined in ET Volume 1 for voltage checks.

MAN-ALOFT

As we mentioned earlier, when you work aloft on radar antennas, your man-aloft chit protects you from the RF radiation hazards. But, you also need to be protected from falling. Do the required PMS for safety harnesses every time you use the harness. And remember, even a good harness can't save you unless you use it right. When you go up the mast attach your harness properly so you can't free fall to the deck. Attach a line to any tools you carry up, so they are unable to fall freely. Set the cut-off switches for any antennas along your way.

WARNING!

**NEVER WORK ALOFT WITHOUT A
SAFETY OBSERVER.**



It's your life; pick good safety observers. Your safety observers should be aware of what type of maintenance you're going to do. They also need to know whom to contact if you run into technical problems.

Safety Observers are responsible for the safety of those walking underneath you as well as for your safety. They should position themselves so you can communicate with them without having to come down. The safety observer will pass your information to everyone else. If something is falling, communicate quickly.

CATHODE-RAY TUBES (CRT'S)

Cathode-ray tubes are part of radar scopes. You will definitely have to work around them. You will probably, at one time or another, pack or unpack, install, repair, or dispose of one. There are some very real dangers associated with handling a CRT. Always take the precautions discussed in ET Volume 1 whenever you handle a CRT.

Never think about electronics without thinking about safety. Learn from the safety information you get from the Ship's Safety Bulletins, Navy mishap reports, and personal experience. Follow established procedures and all safety instructions. Live longer.

We've discussed many aspects of radar in this volume. In ET Volume 7, *Antennas and Wave Propagation*, we will provide specific information about radar antennas, waveguides, and transmission lines. Then in ET Volume 8, *System Concepts*, we will discuss specifics on radar cooling systems.